A3

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 457 470 B1

# (12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
**03.01.1996 Bulletin 1996/01**

(51) Int Cl.6: **F28D 1/03**, F28F 3/04

(21) Application number: **91304036.6**

(22) Date of filing: **03.05.1991**

## (54) Tube for heat exchangers and a method for manufacturing the tube

Rohr für Wärmetauscher und Verfahren zur Herstellung des Rohrs

Tube pour échangeurs de chaleur et méthode de fabrication du tube

(84) Designated Contracting States:
**AT DE FR GB IT SE**

(30) Priority: **11.05.1990 JP 122289/90**
**27.06.1990 JP 200206/90**

(43) Date of publication of application:
**21.11.1991 Bulletin 1991/47**

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Printed by Jouve, 75001 PARIS (FR)

**Description**

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a tube for heat exchangers and a method for manufacturing the tube, more particularly, the tube being of a flat or depressed shape adapted to compose the multiflow heat exchangers which are used as the condensers in car cooler systems.

2. Description of Prior Art

The condensers in the car cooler systems has generally been the heat exchangers of the so-called serpentine-tube type. Cores as the principal parts of such prior art heat exchangers each comprises a "harmonica" tube and fins combined therewith, this tube being a flat extruded tube having internal and longitudinal openings and being bent zigzag several times to thereby form some portions parallel with one another, with each fin being disposed between those portions.

Another kind of prior art heat exchangers is of such a structure as called "multiflow" type, and has recently been proposed and employed to reduce the flow resistance of coolant, to improve the heat transfer efficiency, to render lighter the weight and less thick the volume of the condensers. The multiflow type heat exchangers comprise, for example as shown in Fig. 13, a pair of right and left headers 31 and 32 made of a metal pipe. A plurality of flat tubes 33 are connected at their ends to the headers in fluid communication therewith. Fins 34 are each interposed two adjacent tubes 33 and 33. Partitioning members 35 are each secured inside the headers 31 and 32 at suitable positions intermediate of their ends so that internal spaces of the headers are divided into some longitudinal compartments. Thus, a coolant passage of a zigzag pattern is formed to start from a coolant inlet 36 at an upper end of one header 31 and then to terminate at a coolant outlet 37 at a lower end of the other header 32 ( as disclosed, for example, in the United States Patent No. 4,825,941 ).

The abovementioned tubes 33 in the multiflow type heat exchangers have in general been certain flat or depressed aluminum tubes which are produced by the extrusion forming method and comprise the longitudinally extending openings, because the tubes must withstand well the high pressure of the compressed gaseous coolant employed in the heat exchangers. As shown in Fig. 14, each of those tubes has a peripheral wall 33a which is of a shape of ellipse in its cross section. Each tube has also one or more longitudinal partitions 33b to divide the internal space into some separate coolant paths 33c.

However in all cases wherein the extruded tubes 33 are employed, their height "H" which is restricted by the manufacturing process have been a bottleneck preventing the heat transfer efficiency from being raised above a certain upper limit. As will be understood, higher efficiency of heat transfer within a heat exchanger may be achieved effectively by minimizing the flow resistance of air which flows through the core of a given contour dimension, and at the same time, by increasing the core's overall surface in contact with the air flow. In other words, the extruded tubes 33 of the height "H" which has not been lowered to a sufficient degree have caused an increase of the air flow resistance and placed restrictions on the number of tubes installed within each core of the given contour dimension, thus failing to increase the core's surface contacting the air flow.

Seam-welded pipes have been proposed for use as the tubes in order to eliminate such a drawback ( for example, see the Japanese Patent Publication 62-207572 ). The wall of seam-welded tubes can be rendered sufficiently thin to a thickness of about 0.4 to 0.5 mm, remarkably decreasing the tube's height to about 1.5 to 1.7 mm.

Such an extremely thin wall per se of the seam-welded tubes cannot withstand the high pressure gaseous coolant which is supplied from a compressor to the tubes of the condensers. To resolve this problem, the prior art as disclosed on said Patent Publication 62-207572 makes use of an inner fin member inserted into each flat seam-welded tube. Those inner fin members which are previously corrugated in transverse direction before insertion are each soldered to the inner surface of tube so as to function also as a reinforcing member which enhances to the tube a required resisting pressure.

The prior art tubes seam-welded and reinforced are however not necessarily easy to manufacture. Particularly it is considerably difficult to insert the inner fin member the entire length of each tube which is extremely thin, whereby productivity is lowered raising the manufacturing cost.

The European Patent Appliction No. EP-A-0283937, discloses a tube comprising an inner fin member secured therein. This tube is a combination of a pair of plate members with the inner fin member. Those members have to be manufactured separately, before being set in place to give a pre-assembly of the tube. such a setting operation is however not necessarily easy but rather considerably intricate. The inner fin member held in the pre-assembly must be adjoined to the plate members, whose abutting edges also must be bonded one to another completely and perfectly over the full tube length. In order to ensure a complete and perfect adjoining of the prefabricated members, they must be of an improved and sufficiently high precision.

DE-A-32 45 531 discloses a "rib" which is a "tightly folded gather portion". This patent reference is silent about a possibility that such a "folded portion" is employable as the inner partition or fin member secured in the flat perforated tube for heat exchangers.

BE-A-517964 discloses a flat tube made of a single plate. Fig. 4 shows that the tube comprises three "elemental tubes" integral with each other and arranged side

by side. The tube can not be regarded as a "perforated" flat tube because its inner space for a heat exchanging medium is not divided by any inner partitions into a plurality of flow passages of a "small hydraulic equivalent diameter". It does not suggest that the "curved lugs" therein do function as such "inner partitions" as formed in the flat perforated tubes for the heat exchangers.

An object of the present invention is to provide a tube for heat exchangers which are particularly suited for use as condensers, the tube being not only of a height or thicknesss suppressed to such a degree as ensuring an improved heat transfer efficiency but also being of a higher resisting pressure and easy to manufacture.

Another object of the invention is to provide a method of manufacturing a tube for heat exchangers, which tube has such features as just described in respect of the first object.

According to the present invention a tube for heat exchangers comprises a pair of plane walls spaced a predetermined distance from one another, each plane wall respectively having a lateral end either integrally connected to the lateral end of the other wall by a U-shaped bent portion or having L-shaped portions soldered or welded together to be integral with one another, each plane wall having an opposite lateral end which abuts against and is tightly secured to the opposite lateral end of the other wall to define a flat configuration of the tube, each plane wall including at least one curved lug, protruding towards the other plane wall and extending longitudinally of the tube is characterized in that each curved lug is a tightly folded gather portion of the plane wall, with the gather portion having inner surfaces which are in close contact with one another and soldered one to another, each curved lug being an integral portion of the plane wall and having an innermost top which bears against and is soldered to the inner surface of the other plane wall, the curved lugs alternately protude from one and the other plane walls so as to divide an internal space of the tube into a plurality of separate coolant paths.

Also according to the present invention a method of making a tube for heat exchangers as defined above, comprises the steps of preparing a strip of a predetermined width forming one or more curved lugs protruding from and integral with inner surfaces of both lateral sides of a middle portion of the strip, in such a manner that each curved lug extends longitudinally of the tube and is a tightly folded gather portion of the lateral side, with the gather portion having inner surfaces which are in close contact with one another, bending the strip having the curved lugs at the middle portion into a U-shape in cross-section so as to form plane walls corresponding to the lateral sides, thereafter abutting lateral extremities of the plane walls one to anotehr so that an ellipse in cross-section is formed between the plane walls and innermost tops of the curved lugs of one plane wall do engage with the inner surface of the other plane wall and then fixedly adjoining the inner surfaces of each curved lug one to another, the lateral extremities one to another, and the innermost top to the iner surface with which they engage the curved lugs alternate in transverse direction of the tube so as to divide an internal space of the tube into a plurality of separate coolant paths.

The invention will now be described further, by way of example, with reference to the accompanying drawings, in which:-

Fig. 1 a perspective view of a tube provided according to a first embodiment;

Figs. 2a to 2d are cross-sectional views showing a process for manufacturing the tube in the first embodiment;

Fig. 3 shows a modified tube in the first embodiment;

Fig. 4 is a perspective view of a further modified tube in the first embodiment;

Fig. 5 is a cross-sectional view of a still further modified tube;

Fig. 6 is a cross-sectional view of a tube provided according to a second embodiment of the invention;

Fig. 7 is a plan view of a strip which is being processed to form the tube in the second embodiment;

Fig. 8 is a cross-sectional view taken along the line 8-8 in Fig. 7;

Fig. 9 is a perspective view of a tube provided according to a third embodiment of the invention;

Fig. 10 is a cross-sectional view of a modified tube in the third embodiment;

Fig. 11a is a perspective view showing a further modified tube, with its preformed plates being separated;

Fig. 11b is a cross-sectional view taken along the line 11-11 in Fig. 11a and showing the further modified tube, with its preformed plates being integrated;

Fig. 12a is a perspective view showing a still further modified tube, with its preformed plates being separated;

Fig. 12b is a cross-sectional view taken along the line 12-12 in Fig. 12a and showing the still further modified tube, with its preformed plates being integrated;

Fig. 13 is a front elevation of a heat exchanger in which the tubes of the invention are incorporated;

and

Fig. 14 is a cross-sectional view of a prior art flat tube which is manufactured by the extrusion method.

## THE PREFERRED EMBODIMENTS

### FIRST EMBODIMENT

In a first embodiment shown in Figs. 1 and 2, a tube 1 for heat exchangers comprises a pair of upper and lower plane walls 2 and 3 disposed facing one another and spaced a predetermined distance, for example 0.8 mm, from each other. The plane walls 2 and 3 respectively have one lateral ends integrally connected to each other by a U-shaped bent portion 4. The plane walls further have their other lateral ends which abut against to be tightly welded one to another at a point 5, thereby forming a flat seam-welded pipe of an ellipse-like shape in its cross section. The tube 1 further comprises two curved lugs 6 integral with and protruding inwardly from an inner surface of each plane wall 2 and 3 so that two lugs 6 of one plane wall 2 and two other lugs 6 of the other plane wall 3 alternate in a transverse direction thereof. Each curved lug 6 is formed by inwardly recessing a portion of the plane wall 2 or 3 into a V-shape and by subsequently pressing two opposing legs of "V" into close contact with each other, thereby forming a double-ply wall portion. The curved lugs thus extend longitudinally of the tube 1. An innermost top of each curved lug 6 protruding from one plane wall 2 or 3 bears against the opposite inner surface of the other plane wall 3 or 2. The innermost tops are soldered to said opposite inner surface, while the two contacting V-legs of said double-ply wall portion are also soldered integral with each other. Such a soldering of the abutting or contacting portions is effected by making use of soldering agent layers of a both-sided aluminum brazing sheet which is used to form the tube. Therefore, the soldering may be performed at the same time as fins 34 and tubes 1 are soldered together and tubes 1 and headers 31 and 32 are soldered together when assembling the heat exchanger.

As a result, the curved lugs 6 function as partitions which divide an internal space of the soldered tube 1 into a plurality of separate coolant paths 8 arranged in the transverse direction of tube 1.

Wall thickness "t" of the tube 1 may be 0.15 to 0.5 mm, and more preferably 0.4 mm as an example. Tube width "w" may be 12 to 20 mm, and more preferably 16 mm as an example, with tube height "h" designed to be 1.2 to 2.0 mm, more preferably to be for example 1.6 mm.

In order to manufacture the tube 1, a strip 7 of the aluminum brazing sheet of a predetermined width is prepared to be processed as shown in Fig. 2b. One or more curved lugs 6 are formed by folding longitudinal portions of the strip to protrude in the same direction from surfaces of right and left lateral sides of a transverse middle portion of the strip 7, which portion is bent later. More in detail as shown in Fig. 2a, formed at first are beaded portions 6′ of an "italic-V" shape which has an upright leg perpendicular to the strip surface and an oblique leg inclined toward the upright leg by an angle θ of about 30°. As the next step, each beaded portion 6′ is subjected to a trimming operation wherein the legs thereof are gathered into close contact with each other, thereby producing a desired neat shape of the curved lugs 6 as illustrated in Fig. 2b.

Subsequently, the strip 7 comprising such curved lugs 6 is bent at its transverse middle portion into a U-shape which has a predetermined radius of curvature, as shown in Fig. 2c. Portions adjacent to lateral extremities 7a and 7a are slightly bent in opposite directions so as to abut one on another, with the abutted portions being seam-welded then as denoted by the reference numeral 5 in Fig. 2d. Fig. 2d shows the thus manufactured flat tube 1 in part and on an enlarged scale, the tube having a predetermined dimension and being of an ellipse-shape as a whole in its cross section.

Fig. 3 illustrates a modified tube 1′ comprising curved lugs 6a and 6b which are of a smaller height and protrude from opposite corresponding portions of the upper and lower plane walls 2 and 3, respectively. Innermost tops of the opposite curved lugs 6a and 6b abut one on another and are soldered there to be integral with each other. Other features as well as the manufacturing method are the same as or similar to the tube 1 in the first embodiment.

Fig. 4 shows a further modified tube 1″ which comprises the upper and lower strip-like plane walls 2 and 3 spaced apart, for example, 0.8 mm. The plane walls have one lateral ends integrally connected by the U-shaped bent portion 4, with other lateral ends being soldered one to another to thereby form a flat tube of an ellipse-shape in cross section. The other lateral ends of the walls 2 and 3 have been folded down parallel and inwardly to form creased edges 2a and 3a which are of a predetermined width, before the creased edges 2a and 3a are engaged with and soldered to each other at the region 5. Such a binding structure is more advantageous than the simple abutting and soldering of lateral ends as in the other cases already described, because the binding operation is easier and the soldering process in an oven becomes sure and smooth. The binding of lateral ends may be effected either by the soldering or the seam-welding method. It is preferable to solder said lateral ends at the same time together with other members of heat exchanger in a one-shot operation, wherein the soldering agent layers of both-sided aluminum brazing sheet may be utilized advantageously. In the one-shot operation, the soldering of fins 34 to tubes 1 as well as the soldering thereof to headers 31 and 32 are carried out simultaneously as the lateral ends of tube walls are soldered.

Other features of this modified tube and details of its manufacture are the same as or similar to the tube 1 in the first embodiment.

Fig. 5 shows a still further modified tube 1‴ compris-

ing curved lugs 6a and 6b which are of a smaller height and protrude from opposite corresponding portions of upper and lower plane walls 2 and 3, respectively. Innermost tops of the opposite curved lugs 6a and 6b abut one on another and are soldered there to be integral with each other. Other features of this modified tube and details of its manufacture are the same as or similar to the tube shown in Fig. 4.

SECOND EMBODIMENT

In a second embodiment shown in Figs. 6 to 8, a tube 11 comprises curved lugs 16 which protrude inwardly from separate portions of upper and lower plane walls 12 and 13. Those lugs 16 are provided by recessing the portions of walls 12 and 13 inwardly into semispherical or U-shaped dimple-like shape in cross section. Thus, a plurality of the dimple-like curved lugs 16 are distributed over each plane wall. Respective innermost tops of the lugs 16 on upper wall correspond to and engage with respective innermost tops of the lugs 16 on lower wall so that they are soldered there to be integral with each other. An inner space of the tube 11 becomes a single coolant path 18 of a stray or zigzag pattern due to such scattered dimple-like curved lugs 16. The coolant flowing through this path 18 in the tube 11 will be stirred by the curved lugs 16 to thereby facilitate the exchange of heat.

Details of other structural features of this tube 11 are the same as those of the first embodiment in Figs. 1 and 2, and therefore will not be repeated here.

Similarly to the case shown in Figs. 1 and 2, the tube 11 is made from a strip 17 of aluminum brazing sheet, which strip 17 is of a predetermined width as shown in Figs. 7 and 8. The dimple-like curved lugs 16 are formed at predetermined points of the strip before it is folded into U-shape in cross section at its transverse middle portion, as shown by the phantom line in Fig. 8. After that, the strip's lateral ends abutting one on another are seam-welded as shown by the numeral 5 so as to define a flat depressed tube.

Also in a modification of the second embodiment, the curved lugs 16 on one of the plane walls 12 may also be arranged at positions different from those on the other plane wall 13, in a manner similar to that described hereinbefore. The innermost tops of those lugs engage with the opposite plane wall and are soldered thereto.

THIRD EMBODIMENT

In a third embodiment shown in Fig. 9, a tube 21 is composed of two preformed plates $P_1$ and $P_2$. Curved lugs 26 protruding inwardly and longitudinally of one plate $P_1$ and other ones 26 of the other plate $P_2$ alternate in the transverse direction thereof. The preformed plates are arranged such that their curved lugs are disposed inwardly with lateral ends of said plates, i.e., plane walls, facing one another to be soldered and united. The number of curved lugs 26 is two for each preformed plate.

Both lateral ends of each preformed plate $P_1$ or $P_2$ are L-shaped bent portions 22a or 23a which abut each other and are soldered to be integral with one another. They may not be soldered but welded, if necessary. Other structural features of this tube 21 are the same as those in the first and second embodiments, therefore description thereof being omitted here.

The third embodiment may also be modified such that the curved lugs 26 on the upper plane wall 22 arranged offset to those on the lower plane wall 23, wherein innermost tops of those lugs are engaged with and soldered to each other.

To facilitate the assembling of tube 21, its plates $P_1$ and $P_2$ are preferably set temporarily or preliminarily prior to the soldering thereof. As an example, the edges of L-shaped bent portions 23a of lower plate $P_2$ may be bent again upwards and inwards, along the full length of tube 21′, into a U-shape. Each of the U-shaped edges tightly embraces the corresponding bent portion 22a of upper plate 22a. In detail, the upper and lower L-shaped portions 22a and 22b are formed at first so that the upper one can be slidingly inserted into the lower one.

Fig. 11a illustrates a modified means for the preliminary setting, wherein some tongues 23b are formed to protrude from the outer edge of each L-shaped bent portion 23a of the lower plate $P_2$. Corresponding to the tongues, cutouts 22b are formed on each L-shaped bent portion 22a of the upper plate $P_1$. With the upper plate $P_1$ overlying the lower one $P_2$, the tongues 23b are bent towards the cutouts 22b and folded down onto the edges of L-shaped portion, thereby binding the plates to form a tube 21" as shown in Fig. 11b. Fig. 12a illustrates another modification in which small round ribs 23c protrude upwardly of the L-shaped bent portions 23a of lower plate $P_2$. Respective holes 22c which are formed through the bent portions 22a of upper plate $P_1$ correspond to the respective ribs 23c. Tube 21‴ is assembled as shown in Fig. 12b, by placing the upper plate $P_1$ upon the lower one $P_2$ and then caulking the tops of ribs 23c projecting through the holes 22c so as to secure the ribs therein.

Although the curved lugs 26 extend longitudinally of the tube 21, 21′, 21″ or 21‴, those lugs 16 may be dimple-like protrusions which are formed by recessing the portions of plane walls 22 and 23 inwardly into semispherical shape or U-shape in cross section. In such a case, a plurality of the dimple-like protrusions are distributed over each plane wall. Innermost tops of the upper and lower corresponding protrusions are engaged and soldered integral with each other. Thus, an inner space of the tube becomes a single coolant path of a stray pattern due to such scattered dimple-like protrusions. The coolant flowing through this path will be stirred and assisted by the protrusions to accelerate the heat exchange.

Further, the bent portions of lateral ends may not be bent outwards as in the third embodiment but alternatively be bent inwards.

It will now be apparent that, because either a single thin strip is folded or two thin preformed plates are coupled to form a flat tube for heat exchangers, the tube comprises so thin walls that its height is minimized rendering it to be one of the thinnest types.

It will be understood also that the curved lugs, which protrude from the upper and lower plane walls so as to be engaged and soldered to one another or to the opposite inner surface of the wall, can function as the reinforcing members of the tube, thereby improving its compressive strength and its resistance to internal pressure. Thus, the tube provided for condensers according to the invention is by no means inferior to the flat extruded tube of prior art.

To manufacture the tube of the invention, it is needed merely to apply the conventional integrating technology to the single strip or two plates on which the predetermined curved lugs have been formed. Therefore, the manufacturing process does not involve any difficulty to produce the tubes at a higher productivity and lower manufacturing cost.

Further, in a case wherein the curved lugs extend longitudinally of the tube, its resisting pressure and its flexing strength are increased advantageously. In another case wherein the curved lugs are shaped as the dimples, the coolant is so effectively stirred, while flowing through the tubes' internal paths in the tubes, that their heat exchange efficiency is improved to a remarkable degree.

**Claims**

1. A tube for heat exchangers comprising a pair of plane walls (2, 3 or 22, 23) spaced a predetermined distance from one another, each plane wall respectively having a lateral end either integrally connected to the lateral end of the other wall by a U-shaped bent portion (4) or having L-shaped portions (22a, 23a) soldered or welded together to be integral with one another, each plane wall having an opposite lateral end which abuts against and is tightly secured to the opposite lateral end of the other wall to define a flat configuration of the tube, each plane wall including at least one curved lug (6 or 26), protruding towards the other plane wall and extending longitudinally of the tube (1 or 21), characterized in that each curved lug (6 or 26) is a tightly folded gather portion of the plane wall, with the gather portion having inner surfaces which are in close contact with one another and soldered one to another, each curved lug (6 or 26) being an integral portion of the plane wall and having an innermost top which bears against and is soldered to the inner surface of the other plane wall, the curved lugs (6 or 26) alternately protrude from one and the other plane walls so as to divide an internal space of the tube (1 or 21) into a plurality of separate coolant paths (8).

2. A tube according to claim 1, characterized in that the other lateral ends of the plane walls (2, 3) comprise creased edges (2a, 3a) which are. abutted in parallel with and secured integral to each other.

3. A tube according to claim 1, characterized in that both lateral ends of the preformed plates (22, 23) comprise bent portions (22a, 23a) which are abutted in parallel with and soldered integral to each other.

4. A method of making a tube for heat exchangers as defined in claim 1, comprising the steps of preparingastrip of a predetermined width forming one or more curved lugs protruding from and integral with inner surfaces of both lateral sides of a middle portion of the strip, in such a manner that each curved lug extends longitudinally of the tube and is a tightly folded gather portion of the lateral side, with the gather portion having inner surfaces which are in close contact with one another, bending the strip having the curved lugs at the middle portion into a U-shape in cross-section so as to form plane walls corresponding to the lateral sides, thereafter abutting lateral extremities of the plane walls one to another so that an ellipse in cross-section is formed between the plane walls and innermost tops of the curved lugs of one plane wall do engage with the inner surface of the other plane wall and then fixedly adjoining the inner surfaces of each curved lug one to another, the lateral extremities one to another, and the innermost top to the inner surface with which they engage the curved lugs alternate in transverse direction of the tube so as to divide an internal space of the tube into a plurality of separate coolant paths.

5. A method according to claim 4, characterized in that the strip is a brazing sheet comprising a core material having both sides covered with a soldering agent layer, the abutted lateral extremities are seam welded and subsequently the inner surfaces of each curved lug are soldered one to another, the innermost tops being soldered to the inner surface with which they engage, by means of the layer.

6. A method according to claim 4, characterized in that the strip is a brazing sheet comprising a core material having both sides covered with a soldering agent layer and in one shot operation the abutted lateral extremities are soldered one to another, the inner surfaces of each curved lug are soldered one to another and the innermost tops are soldered to the inner surface, with which they engage, by means of the layer.

**Patentansprüche**

1. Rohr für Wärmetauscher mit einem Paar glatter

Wände (2, 3 oder 22, 23), die in einem vorbestimmten Abstand voneinander angeordnet sind, wobei jede glatte Wand einen seitlichen Randbereich aufweist, der entweder durch einen U-förmigen Biegeabschnitt (4) an den seitlichen Randbereich der anderen Wand angeformt ist oder der L-förmige Abschnitte (22a, 23a) aufweist, die durch Löten oder Schweißen miteinander verbunden sind, wobei jede glatte Wand einen gegenüberliegenden seitlichen Randbereich aufweist, der an den gegenüberliegenden seitlichen Randbereich der anderen Wand angrenzt und an dieser dichtend gesichert ist, um so ein flaches Rohr zu bilden, und wobei jede glatte Wand wenigstens einen gekrümmten Vorsprung (6 oder 26) aufweist, der zur anderen glatten Wand hin hervorragt und der sich in Längsrichtung des Rohres (1 oder 21) erstreckt, **dadurch gekennzeichnet**, daß jeder gekrümmte Vorsprung (6 oder 26) ein eng gefalteter Abschnitt der glatten Wand ist, wobei dieser Bereich Innenflächen aufweist, die in ,engem Kontakt zueinander angeordnet und miteinander verlötet sind, wobei jeder gekrümmte Vorsprung (6 oder 26) Teil der glatten Wand ist und einen inneren Scheitelbereich aufweist, der an der Innenseite der anderen glatten Wand anliegt und mit dieser verlötet ist, wobei die gekrümmten Vorsprünge (6 oder 26) wechselweise von der einen bzw. der anderen glatten Wand hervorragen, um auf diese Weise einen Innenraum des Rohres (1 oder 21) in eine Vielzahl separater Kühlmitteldurchlässe (8) zu unterteilen.

2. Rohr nach Anspruch 1, **dadurch gekennzeichnet**, daß die anderen seitlichen Randbereiche der glatten Wände (2, 3) gefalzte Kanten (2a, 3a) aufweisen, die parallel angeordnet aneinandergrenzen und fest miteinander verbunden sind.

3. Rohr nach Anspruch 1, **dadurch gekennzeichnet**, daß beide seitlichen Randbereiche der vorgeformten Platten (22, 23) gebogene Bereiche (22a, 23a) aufweisen, die parallel angeordnet aneinandergrenzen und miteinander verlötet sind.

4. Verfahren zur Herstellung eines Rohres für Wärmetauscher nach Anspruch 1, welches die Schritte umfaßt: Vorbereiten eines Streifens in einer vorbestimmten Breite, Erstellen von einem oder mehreren gekrümmten Vorsprüngen, die Teil der Innenseiten der Seitenbereiche eines mittleren Streifenabschnitts sind und von diesem hervorragen, so daß sich jeder gekrümmte Vorsprung in Längsrichtung des Rohres erstreckt und ein eng gefalteter Bereich des Seitenbereichs ist, wobei der Bereich Innenflächen aufweist, die in engem Kontakt zueinander angeordnet sind, Biegen des Streifens mit den gekrümmten Vorsprüngen in dessem mittleren Abschnitt in eine Uförmige Querschnittsform, um auf diese Weise den Seitenbereichen entsprechende glatte Wände zu erstellen, anschließendes Aneinanderführen der seitlichen Randbereiche der glatten Wände, so daß im Querschnitt eine Ellipse zwischen den glatten Wänden und den inneren Scheitelbereichen der gekrümmten Vorsprünge einer glatten Wand gebildet wird, wobei die inneren Scheitelbereiche an die andere glatte Wand grenzen, und anschließendem festem Verbinden der Innenflächen jedes gekrümmten Vorsprunges miteinander, der seitlichen Randbereiche miteinander und der inneren Scheitelbereiche mit der Innenseite, an der die gekrümmten Vorsprünge anliegen, wobei diese in Querrichtung des Rohres wechselweise angeordnet sind, um auf diese Weise einen Innenraum des Rohres in eine Vielzahl separater Kühlmitteldurchlässe zu unterteilen.

5. Verfahren nach Anspruch 4, **dadurch gekennzeichnet**, daß der Streifen ein Lötblech mit einem Kernmaterial ist, das beidseitig mit einer Lötmittelschicht beschichtet ist, daß die aneinandergrenzenden Seitenbereiche nahtgeschweißt sind, daß anschließend die Innenflächen von jedem gekrümmten Vorsprung miteinander verlötet werden, und daß die inneren Scheitelbereiche mit den Innenseiten, an denen sie anliegen, verlötet werden.

6. Verfahren nach Anspruch 4, **dadurch gekennzeichnet**, daß der Streifen ein Lötblech mit einem Kernmaterial ist, das beidseitig mit einer Lötmittelschicht beschichtet ist und daß in einem Vorgang die aneinandergrenzenden seitlichen Randbereiche miteinander, die Innenflächen von jedem gekrümmten Vorsprung miteinander und die inneren Scheitelbereiche mit der an diese angrenzenden Innenseite verlötet werden.

**Revendications**

1. Tube pour échangeurs de chaleur, comprenant une paire de parois planes (2, 3 ou 22, 23) espacées l'une de l'autre d'une distance prédéterminée, chaque paroi plane présentant respectivement une extrémité latérale soit connectée de manière solidaire à l'extrémité latérale de l'autre paroi, par l'intermédiaire d'une partie recourbée en forme de "U" (4), soit présentant des parties en forme de "L" (22a, 23a) assemblées par brasage ou soudage, de manière à être solidaires l'une de l'autre, chaque paroi plane présentant une extrémité latérale opposée qui aboute à l'extrémité latérale opposée de l'autre paroi, et est fixée de manière serrée à celle-ci, pour définir une configuration plane du tube, chaque paroi plane comportant au moins une patte recourbée (6 ou 26), en saillie vers l'autre paroi plane et s'étendant dans le sens longitudinal du tube (1 ou 21), caractérisé en ce que chaque patte recourbée

(6 ou 26) est une partie assemblée, repliée de manière serrée, de la paroi plane, la partie assemblée présentant des surfaces intérieures qui se trouvent en contact étroit l'une avec l'autre et qui sont brasées l'une à l'autre, chaque patte recourbée (6 ou 26) étant une partie solidaire de la paroi plane et présentant une partie supérieure intérieure qui s'appuie sur la surface intérieure de l'autre paroi plane, et est brasée à celle-ci, les pattes recourbées (6 ou 26) faisant alternativement saillie par rapport à l'une et l'autre paroi plane, de manière à diviser un espace intérieur du tube (1 ou 21) en une pluralité de trajectoires de réfrigérant séparées (8).

2. Tube suivant la revendication 1; caractérisé en ce que les autres extrémités latérales des parois planes (2, 3) comprennent des bords tombés (2a, 3a) qui sont placés bout à bout, en parallèle, et fixés de manière solidaire l'un à l'autre.

3. Tube suivant la revendication 1, caractérisé en ce que les deux extrémités latérales des plaques préformées (22, 23) comprennent des parties recourbées (22a, 23a) qui sont placées bout à bout, en parallèle, et brasées de manière solidaire l'une à l'autre.

4. Procédé de réalisation de tube pour échangeurs de chaleur suivant la revendication 1, comprenant les étapes consistant à préparer une bande d'une largeur prédéterminée, former une ou plusieurs pattes recourbées faisant saillie par rapport à des surfaces intérieures des deux côtés latéraux d'une partie centrale de la bande, et solidaires de celles-ci, de telle manière que chaque patte recourbée s'étende dans le sens longitudinal du tube et est une partie assemblée, repliée de manière serrée, du côté latéral, la partie assemblée présentant des surfaces intérieures qui se trouvent en contact étroit l'une avec l'autre, recourber la bande présentant les pattes recourbées, dans une partie centrale, en une section en forme de "U", de manière à former des parois planes correspondant aux côtés latéraux, ensuite placer bout à bout les extrémités latérales des parois planes, de manière à former une section en forme d'ellipse entre les parois planes et que les parties supérieures intérieures des pattes recourbées de l'une des parois planes viennent en prise avec la surface intérieure de l'autre paroi plane et, ensuite, joindre de manière fixe les surfaces intérieures de chaque patte recourbée l'une à l'autre, les extrémités latérales l'une à l'autre et la partie supérieure intérieure à la surface intérieure avec laquelle elle vient en prise, avec les pattes recourbées, alternativement, dans le sens transversal du tube, de manière à diviser un espace intérieur du tube en une pluralité de trajectoires de réfrigérant séparées.

5. Procédé suivant la revendication 4, caractérisé en ce que la bande est une feuille à braser comprenant un matériau de noyau présentant les deux côtés recouverts d'une couche de brasure, que les extrémités latérales placées bout à bout sont soudées en continu et que, successivement, les surfaces intérieures de chaque patte recourbée sont brasées l'une à l'autre, les parties supérieures intérieures étant brasées à la surface intérieure avec laquelle elles viennent en prise, à l'aide de la couche.

6. Procédé suivant la revendication 4, caractérisé en ce que la bande est une feuille à braser comprenant un matériau de noyau présentant les deux côtés recouverts d'une couche de brasure et qu'en une seule opération les extrémités latérales placées bout à bout sont brasées l'une à l'autre, les surfaces intérieures de chaque patte recourbée sont brasées l'une à l'autre et les parties supérieures intérieures sont brasées à la surface intérieure avec laquelle elles viennent en prise, à l'aide de la couche.

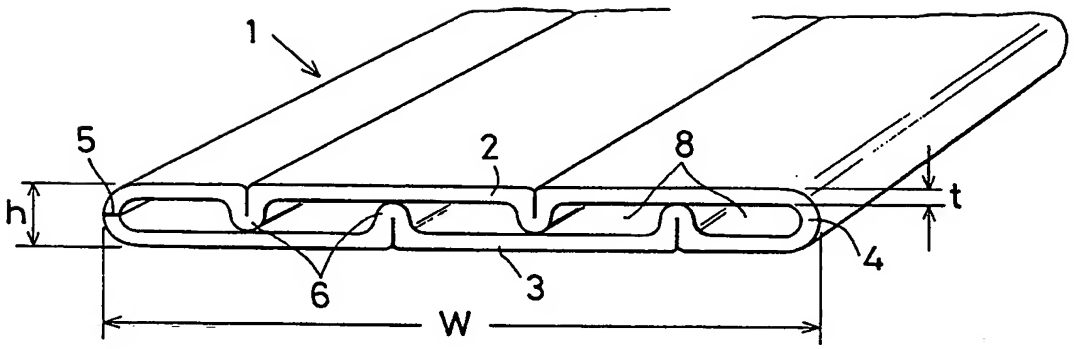
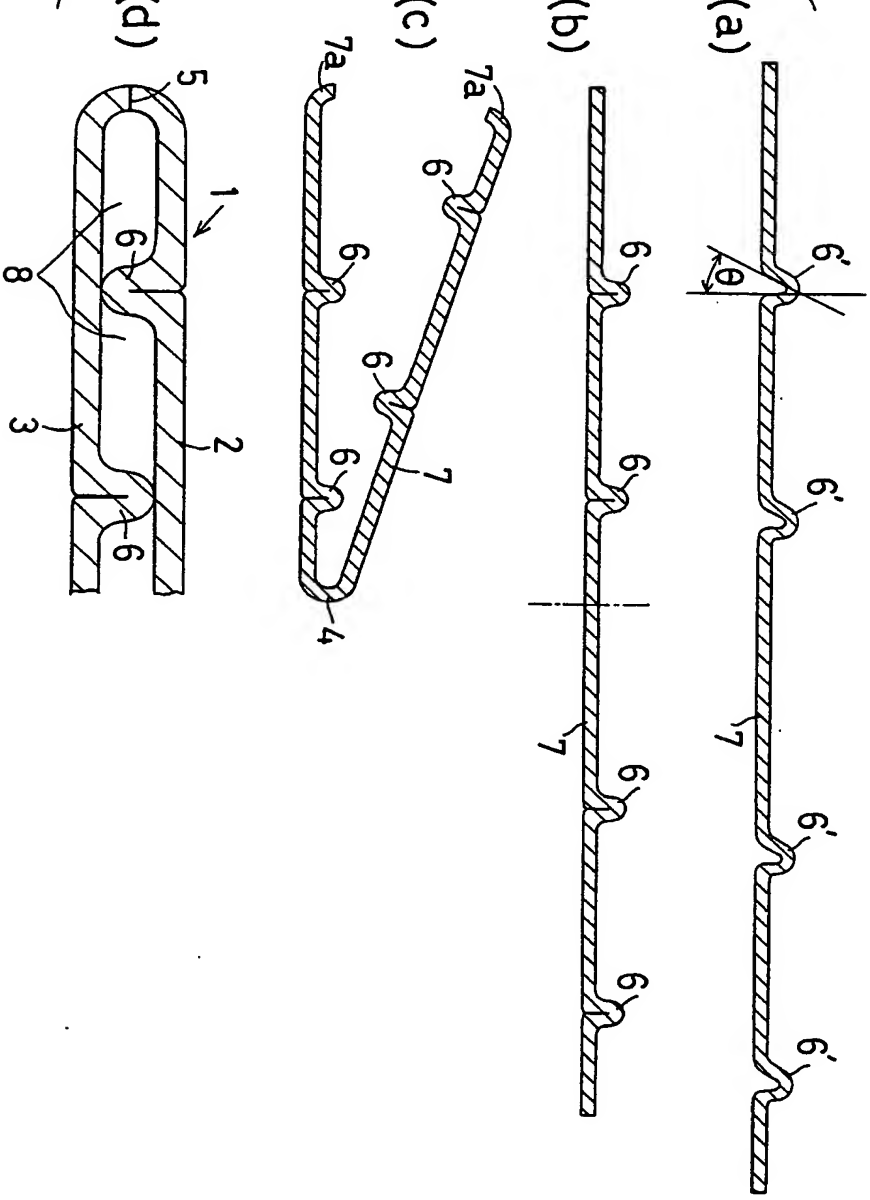



FIG. 1

FIG. 2



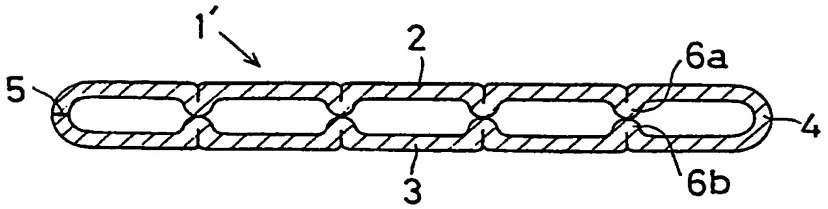



FIG. 3

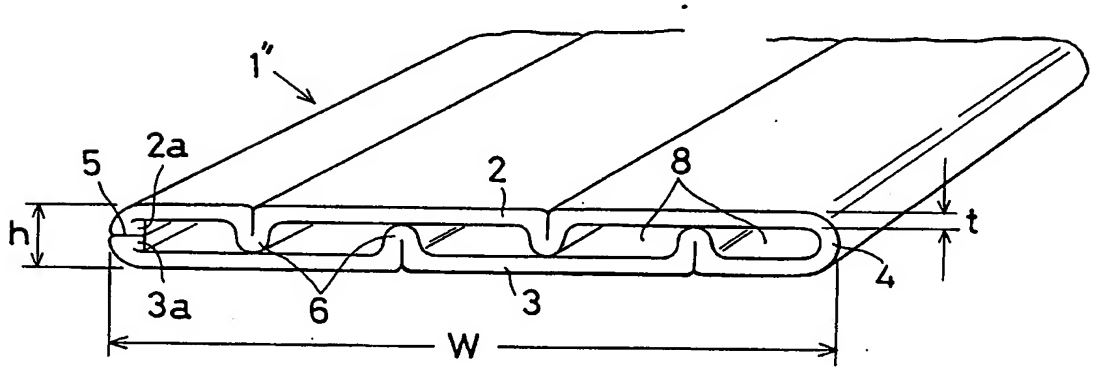



FIG. 4

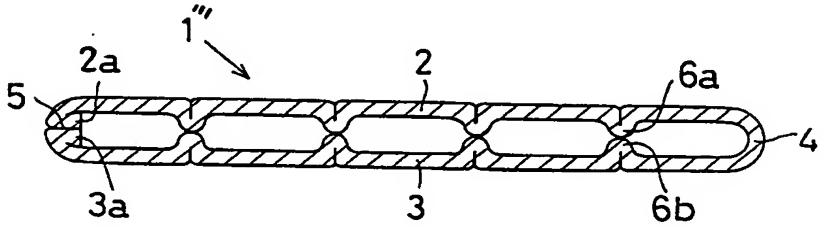



FIG. 5

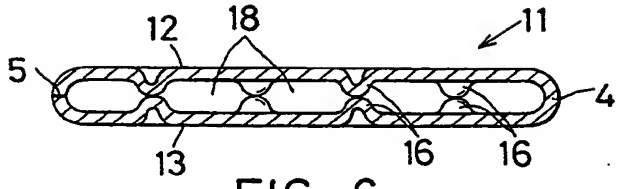



FIG. 6

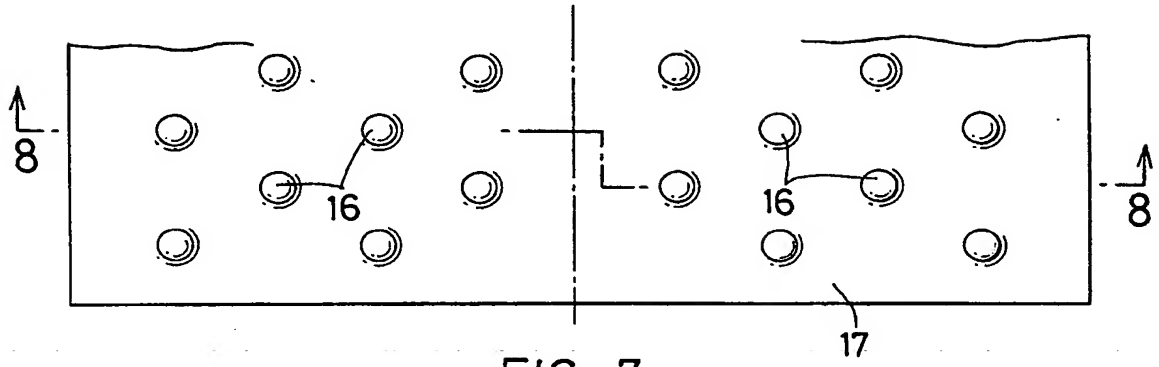



FIG. 7

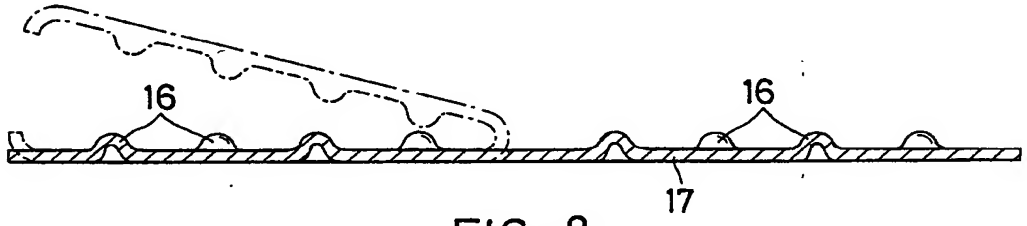



FIG. 8

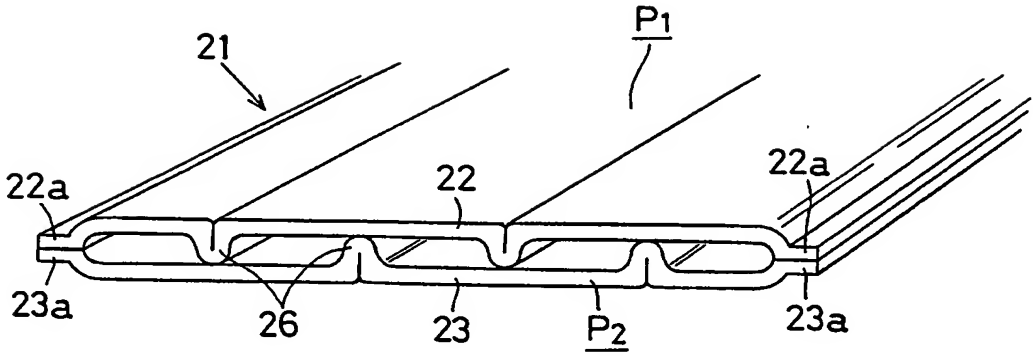



FIG. 9

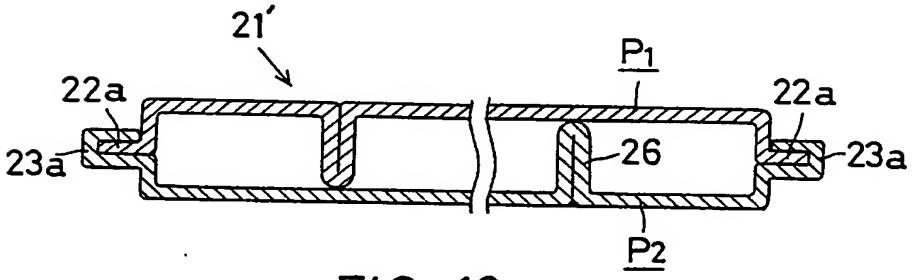



FIG. 10

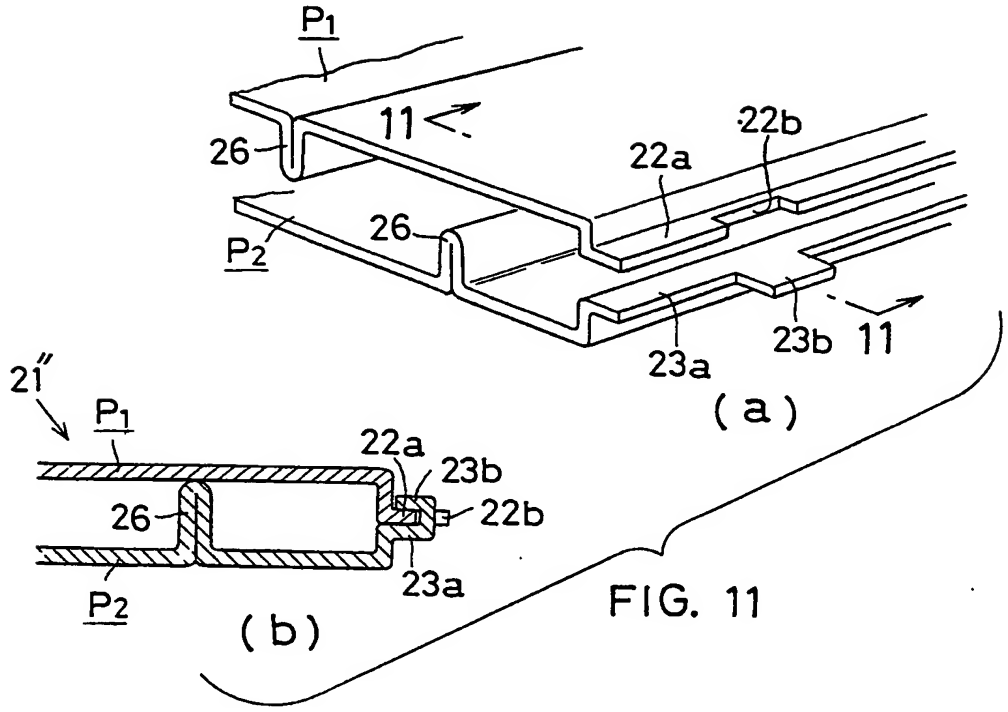

P1
11
26
22b
22a
26
P2
23a
23b
11
(a)
21''
P1
22a
23b
26
22b
P2
23a
(b)

FIG. 11

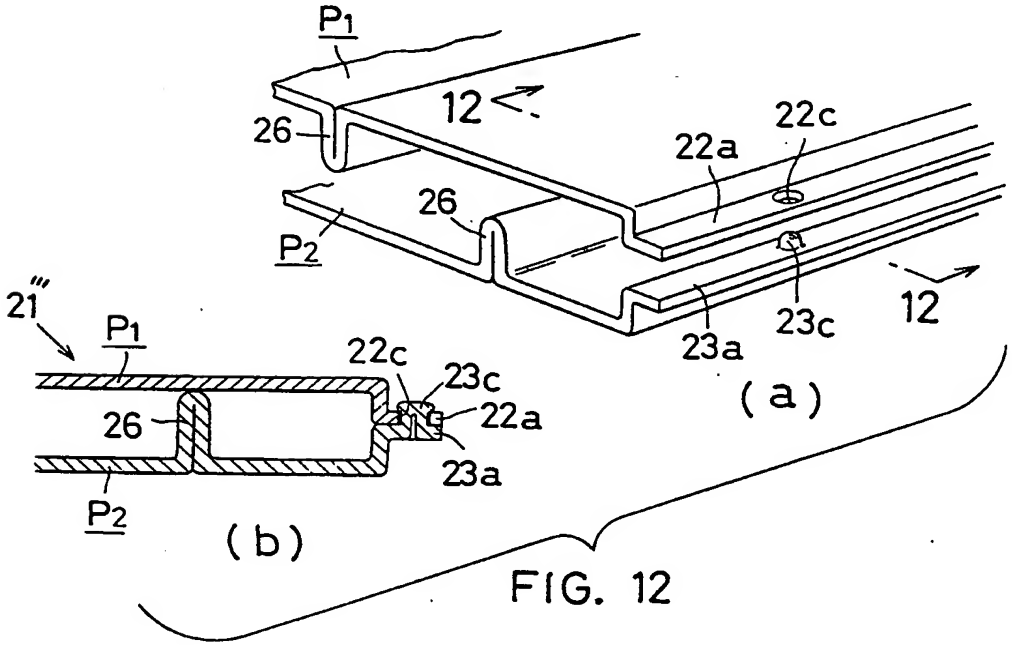

P1
12
26
22c
22a
26
P2
23a
23c
12
(a)
21'''
P1
22c
23c
26
22a
23a
P2
(b)

FIG. 12

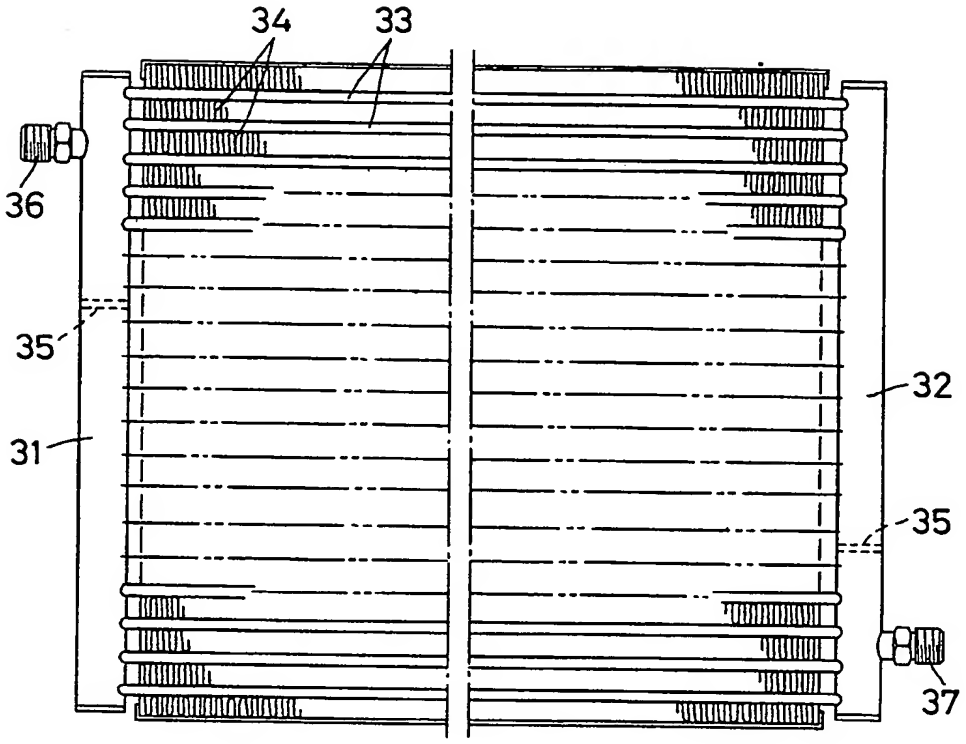



FIG. 13

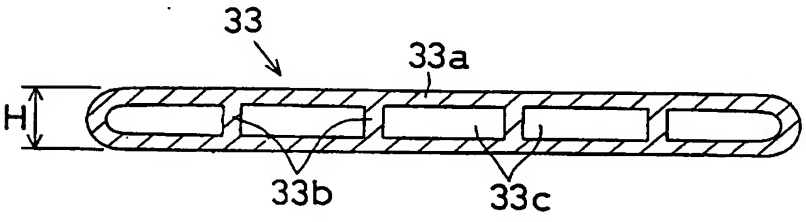



FIG. 14